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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CHIHIRO ARAKI

Appeal 2008-3495
Application 10/063,870
Technology Center 1700

Decided: September 4, 2008

Before CHUNG K. PAK, LINDA M. GAUDETTE, and
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

PAK, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the Examiner's final rejection of claims 1 through 14, all of the pending claims in the above-identified application. We have jurisdiction pursuant to 35 U.S.C. § 6.

We AFFIRM-IN-PART.

STATEMENT OF THE CASE

The subject matter on appeal is directed to a method and apparatus for bonding a metallic wire, particularly a wire lead, to a semiconductor device (Spec. 1, para. 0001 and Spec. 2, para. 0007). Further details of the appealed subject matter are recited in representative claims 1, 6, and 9 reproduced below[1]:

1. A wire bonding method for pressure welding a metallic wire to device while applying ultrasonic vibration, said method comprising the steps of applying pressure between the metallic wire and the device and simultaneously applying a vibratory force thereto, detecting the degree of bonding between the metallic wire and the device, and stopping the application of ultrasonic vibration and pressure in response to the detection of completion of the state of bonding.

6. A wire bonding method as set forth in claim 5 wherein the completion of bonding is determined from an abrupt change of the waveform of the feedback signal.

9. A wire bonding method as set forth in claim 5 wherein the completion of bonding is determined from a lack of significant change in the waveform of the feedback signal.

The Examiner has rejected claims 1 through 14 under 35 U.S.C. § 102(b) as anticipated by the disclosure of US. Patent 5,433,369 issued to Okumura on July 18, 1995 (Okumura).

Appellant appeals from the Examiner's decision rejecting the claims on appeal under 35 U.S.C. § 102(b).

[1] We address the claims on appeal separately to the extent that they have been argued separately by Appellant. *See* 37 C.F.R. § 41.37(c)(1) (vii) (2005).

RELEVANT FACTUAL FINDINGS (FF)

1. Okumura teaches a wire bonding apparatus and method for using at least ultrasonic energy as bonding means in manufacturing a semiconductor device (col. 1, ll. 5-10).

2. Okumura explains (col. 1, ll. 11-23) that:

> One of the many assembly processes for manufacturing a semiconductor device is what is known as the wire bonding process for connecting an electric terminal on a semiconductor chip with a lead terminal on a package of a lead frame or the like by a thin metallic wire. In this process, an end of the thin metallic wire is pressed against a bonding pad to bond it. The bonding is frequently performed by the ultrasonic method or ultrasonic thermocompression bonding method in addition to the thermocompression bonding method. A wire bonding apparatus and bonding process according to a general ultrasonic thermocompression bonding method are described below by referring to FIGS. 2 and 3.

3. Appellant acknowledges that it is known that "[m]any forms of circuits employ semiconductors mounted on circuit boards. Semiconductor device production processes include a wire bonding process by which a semiconductor chip is mounted on a lead frame or a substrate" (Spec. 1, para 0002).

4. Okumura teaches employing in the above wire bonding method a wire bonding apparatus for bonding wire to a bond electrode (a bonding pad of a semiconductor chip) by using at least ultrasonic vibration, comprising:

> [A]n oscillator for outputting a high-frequency voltage, an ultrasonic vibrator driven by the high-frequency voltage, electric power detection means for detecting a decrease of

> power supply due to contact between the bonding wire and the electrode by detecting a feedback current outputted from the ultrasonic vibrator, and level change means for changing high-frequency voltage levels outputted from the oscillator so as to complement the decrease of power supply detected by the electric power detection means. [*See* col. 2, ll. 18-31, col. 1, ll. 24-36, and col. 3, ll. 4-10.]

5. In terms of detecting the above feedback current, Okumura teaches that:

> A feedback-current detection resistance **23** for detecting a feedback current is connected between the ultrasonic vibrator **15** and ground, and a voltage corresponding to a feedback current **25** (hereafter referred to as feedback-current indication voltage) is generated at one end of the resistance **23**. The feedback-current indication voltage **26** is inputted to the electric-power calculation circuit **21** of the electric-power control section **19** and the PLL circuit **18**. The electric-power calculation circuit **21** calculates electric power from the feedback current **25** obtained from the feedback-current indication voltage **26** and the oscillating voltage **24** output by the oscillator **11** and inputs the calculated electric power to the correction circuit **22**. The correction circuit **22** inputs a control voltage **27** for compensating the calculated electric power value to the level setting circuit **12** in correspondence with the calculated electric power value. [*See* col. 3, ll. 33-50.]

6. Okumura teaches that the degree of the contact ("a mechanical contact resistance when the ball [i.e., part of the thin metallic wire,] is bonded with the chip pad by . . .") between the bonding wire and the electrode (bonding pad), which corresponds to the degree of bonding between the wire and the electrode, determines the level of the high-frequency voltage to be outputted from the oscillator so as to provide a constant electric power to the joint (col. 1, l. 65 to col. 2, l. 11, col. 2, ll. 32-49, and col. 3, ll. 11-55).

7. Okumura teaches that after bonding the first electrode (chip pad) in the above manner, the same operation can be performed to bond the second electrode, thus indicating the employment of the second electrode bonding upon detection or observation of the completion of the first electrode bonding (col. 4, ll. 26-30).

8. Okumura illustrates completion of the bonding of the first and second electrodes with a metal wire, which can be observed (detected by eyes) from Figs. 3(a) to 3(e).

9. Okumura does not teach a step or an arrangement for terminating the bonding process upon an abrupt change of or a lack of significant change in the waveform of the feedback signal from the oscillator.

PRINCIPLES OF LAW

Anticipation under 35 U.S.C. § 102(b) is established only when a single prior art reference discloses, either expressly or under the principle of inherency, each and every element of a claimed invention. *See, e.g., In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990).

ANALYSES AND ISSUES

CLAIMS 1-5, AND 12

Okumura teaches a wire bonding process and apparatus for pressure bonding (welding) a thin metallic wire to a bonding pad (electrode) of a semiconductor chip on substrates (e.g., lead frame or the like) of various semiconductor devices while applying a vibratory force with an ultrasonic vibrator driven by a high-frequency voltage from an oscillator (FF 1- 4).

Appellant's principal argument is that Okumura does not teach detecting the degree of bonding between the metallic wire and the bonding pad of a semiconductor device as recited in claims 1 and 12 and "stopping the application of ultrasonic vibration and pressure in response to the detection of completion of the state of bonding" as recited in claim 1 (Br. 3)

Thus, the dispositive questions is: Has Appellant shown reversible error in the Examiner's finding that Okumura teaches detecting the degree of bonding between the metallic wire and the bonding pad as recited in claims 1 and 12 and "stopping the application of ultrasonic vibration and pressure in response to the detection of completion of the state of bonding" as recited in claim 1? On this record, we answer this question in the negative.

As indicated *supra*, Okumura determines the degree of contact ("a mechanical contact resistance when the ball [i.e., part of the thin metallic wire,] is bonded with the chip pad by . . .") between the thin metallic wire and the bonding pad of a semiconductor device for the purpose of supplying a constant electric power (FF 4-6). Determination of this degree of contact between the bonded wire and chip pad necessarily indicates the degree of bonding between the same (*id.*). This degree of contact (bonding) is determined at least by a feedback signal from an oscillator (FF 4). Upon completion of the bonding between the wire and the first bonding pad, Okumura illustrates stopping the application of vibratory force and pressure to bond a different portion of the wire to a second bonding pad (FF 7-8). The completion of the first bonding is inherently or necessarily detected or observed prior to carrying out the second bonding operation. Thus, we concur with the Examiner that Okumura necessarily or inherently detects or

observes the degree of bonding and the completion of the first bonding involved within the meaning of 35 U.S.C. § 102(b).

CLAIMS 6-11, 13, AND 14

Claims 6 through 11, 13, and 14 require a step or an arrangement (device) for terminating the bonding process in response to an abrupt change of or a lack of significant change in the waveform of the feedback signal from the oscillator (completion of the bonding). Appellant contends that Okumura does not teach such a step or an arrangement (device) (Br. 4).

Thus, the dispositive question is: Has the Examiner reversibly erred in finding that Okumura teaches a step or an arrangement (device) for terminating the bonding process in response to an abrupt change of or a lack of significant change in the waveform of the feedback signal from the oscillator within the meaning of 35 U.S.C. § 102(b)? On this record, we answer this question in the affirmative.

According to the Examiner at pages 3 and 6 of the Answer, Okumura at col. 3, ll. 11-50, and col. 4, ll. 31-32, teaches a step and an arrangement (device) for terminating the bonding process in response to an abrupt change of the waveform of the feedback signal from the oscillator (completion of the bonding). However, no such teaching can be found in the columns and lines of Okumura referred to by the Examiner (FF 9). Moreover, the Examiner has not responded to Appellant's argument that Okumura does not teach terminating the bonding process in response to a lack of significant change in the waveform of the feedback signal from the oscillator (completion of the bonding). The Examiner's mere reference to Okumura's

thermocompression method employing ultrasonic waves does not explain, much less show, the application of the claimed step and arrangement (device) in question in Okumura's process or apparatus. Accordingly, we are constrained to agree with Appellant that the Examiner has not established a prima facie case of anticipation of the subject matter recited in claims 6 through 11, 13, and 14 within the meaning of 35 U.S.C. § 102(b).

ORDER

In view of the foregoing, we affirm the Examiner's decision rejecting claims 1 through 5, and 12 under 35 U.S.C. § 102(b), but reverse the Examiner's decision rejecting claims 6 through 11, 13, and 14 under 35 U.S.C. § 102(b).

TIME PERIOD

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED-IN-PART

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